Radiation Report on **OP400AYMDA (DC: 2B0404F)**
Project: AIM

A radiation evaluation was performed on **The OP400AYMDA, Quad Low Offset, Low Power Operational Amplifier(Analog Devices)** to determine the total dose tolerance of these parts. The total dose testing was performed using a Co^{60} gamma ray source. During the radiation testing, five devices were irradiated under bias, see figure 1. One part was used as a control sample,. The total dose radiation levels were 1, 5, 10, 15, and 20kRads(Si). The average dose rate was 67.98 rads(Si)/min. After the 20krad(Si) irradiation, the parts were annealed under bias at 25°C for 168 hours. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III. An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step.

All devices met the manufacturer's datasheet specifications for all tested parameters at the 1 krad(Si) radiation step.
At the 5krad(Si) step all devices exceeded the manufacturer's specified positive bias current maximum of 2nA by an average of 0.33 nA. At subsequent radiation levels the devices continued to degrade, exceeded the 2nA maximum by an average of 2.38nA at 10krad(Si), 5.62nA at 15krad(Si), 8.82nA at 20krad(Si), and 4.90nA Post Anneal.
At the 10krad(Si) radiation step two devices (DUT3 & DUT4) exceeded the manufacturer's specified negative bias current maximum of 2nA by 1.19nA & 1.05nA. The devices continued to degrade, at the subsequent radiation levels, all devices exceeded the 2nA maximum by an average of 3.22nA at15krad (Si), 5.20nA at 20krad(Si), and 2.95nA Post Anneal
All devices met the manufacturer's datasheet maximum of 1nA for Input offset current up to the 5krad(Si) radiation level. At the 10krad(Si) radiation step, all devices exceeded the 1nA specified maximum by an average of 0.42nA. The devices continued to degrade at subsequent radiation steps, The devices continued to degrade, at the subsequent radiation levels, all devices exceeded the 1nA maximum by an average of 0.42nA at 10krad(Si), 1.36nA at 15krad(Si), 2.62nA at 20krad(Si), and 0.94nA Post Anneal

Initial electrical measurements were made on 6 samples. Five samples were irradiated (1, 2, 3, 4, 5)) and device number C was used as a control sample, but due to an oversight of the test engineer, the control device was only characterized prior to radiation. All devices had the following external markings on the package: 5962-8777101MCA; Amp400; 2B0404F. During test, one of the four internal opamps of the device were tested

All parts passed all parametric tests up to and including 1krad(Si)

At the 5krad(Si) step all devices exceeded the manufacturer's specified positive bias current maximum of 2nA by an average of 0.33 nA. At subsequent radiation levels the devices continued to degrade, exceeded the 2nA maximum by an average of 2.38nA at 10krad(Si), 5.62nA at 15krad(Si), 8.82nA at 20krad(Si), and 4.90nA Post Anneal.
At the 10krad(Si) radiation step two devices (DUT3 & DUT4) exceeded the manufacturer's specified negative bias current maximum of 2nA by 1.19nA & 1.05nA. The devices continued to degrade, at the subsequent radiation levels, all devices exceeded the 2nA maximum by an average of 3.22nA at15krad (Si), 5.20nA at 20krad(Si), and 2.95nA Post Anneal
All devices met the manufacture's datasheet specification for input offset voltage and swing voltsge

Table III provides a summary of the test results with the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

TABLE I. Part Information

Generic Part Number:	OP400AYMDA
Full Part Number	5962-8777101MCA
Manufacturer:	Analog Devices
Lot Date Code (LDC):	2B0404F
Quantity Tested:	6
Serial Numbers of Control Sample:	6
Serial Numbers of Radiation Samples:	1, 2, 3, 4, 5
Part Function:	OPAMP
Part Technology:	Bipolar
Package Style:	14 pin dip
Test Equipment:	HP4156B Precision Semiconductor Parameter Analyzer; HP E3611A DC Power Supply
Test Engineer:	C. Palor / A. Pham

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for OP200AZMDA

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	01/04/05
2) 1 KRAD IRRADIATION (14 RADS (Si)/MIN)	1/4/2005
POST-1 KRAD ELECTRICAL MEASUREMENT	1/4/2005
3) 5 KRAD IRRADIATION (93 RADS (Si)/MIN)	1/4/2005
POST-5 KRAD ELECTRICAL MEASUREMENT	1/4/2005
4) 10 KRAD IRRADIATION (4.9 RADS (Si)/MIN)	1/5/2005
POST-10 KRAD ELECTRICAL MEASUREMENT	1/5/2005
5) 15 KRAD IRRADIATION (114 RADS (Si)/MIN)	1/5/2005
POST-15 KRAD ELECTRICAL MEASUREMENT	1/5/2005
6) 20 KRAD IRRADIATION (6.84 RADS (Si)/MIN)	1/5/2005
POST-20 KRAD ELECTRICAL MEASUREMENT	

Average Dose Rate = 67.98 rads (Si)/min

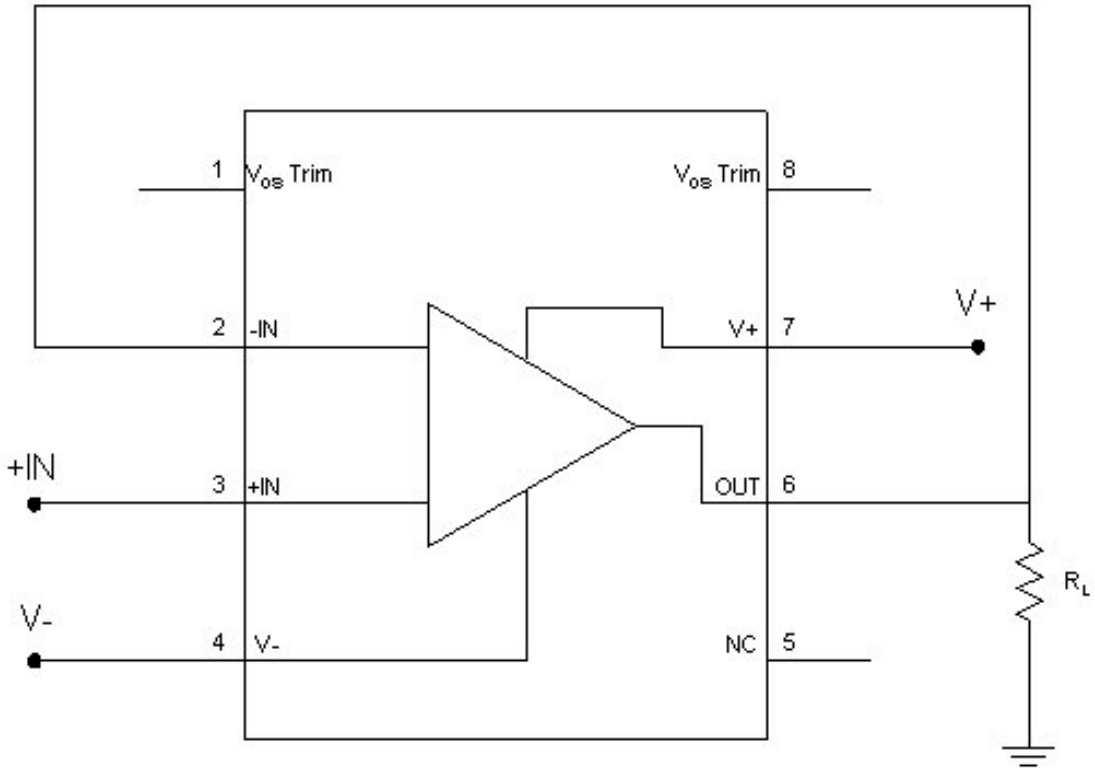

Figure 1. OP400AYMDA Bias Circuit

Table III. Electrical Characteristics OP400AYMDA

						Total Dose Exposure (kRads Si)												Annealing	
Test				Spec. Lim. (2)		Initial		1		5		10		15		20		168 hours @25°C	
#	Parameters	condition	Units	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	+IB	VS = ±15 V, TA = 25 C,	nA	--		0.50	6.59E-02	0.79	9.89E-02	2.33	9.02E-02	4.38	3.17E-01	7.62	4.94E-01	10.82	3.74E-01	6.90	4.32E-01
2	-IB	VS = ±15 V, TA = 25 C,	nA	--		0.40	4.82E-02	0.55	4.98E-02	1.63	7.98E-02	2.96	1.61E-01	5.22	2.92E-01	7.20	3.16E-01	4.95	2.76E-01
3	I_{IO}	VS = ±15 V, TA = 25 C, V_{CM} = °V	nA	--		0.11	7.74E-02	0.24	1.28E-01	0.70	1.51E-01	1.42	2.75E-01	2.36	2.73E-01	3.62	1.31E-01	1.94	2.35E-01
4	V_{IO}	VS = ±15 V, TA = 25 C	µV	--		-110.00	5.16E+01	-30.00	8.37E+01	-90.00	5.48E+01	-90.00	5.48E+01	-75.00	5.48E+01	-70.00	4.47E+01	-10.00	5.48E+01
5	V_{SWING}	VS = ±15 V, –55 C < TA = 125 C; R_L = 2 kΩ	V	±11		±13.97	2.77E-03	±13.98	3.05E-03	±13.97	7.38E-02	±14.14	2.52E-01	±14.05	4.66E-02	±14.07	1.40E-02	±14.07	3.46E-03